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Enumeration and Biological Data from the Upstream Migration of Arctic Charr, *Salvelinus alpinus* (L.), in the Cambridge Bay Area, Northwest Territories, 1979-1983

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by

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ABSTRACT

McGowan, D.K. 1990. Enumeration and biological data from the upstream migration of Arctic charr, Salvelinus alpinus (L.), in the Cambridge Bay area, Northwest Territories, 1979-1983. Can. Data Rep. Fish. Aquat. Sci. 811: iv + 27 p.

In 1978 a stock identification and assessment program was initiated in the Cambridge Bay area. A weir, or counting fence, was used to enumerate the upstream migration of Arctic charr in four commercially fished rivers. A summary of the number of charr counted, tagged and live sampled, the biological data collected and the timing of the migrations are presented. Biological data collected include length, weight, age and maturity characteristics from a stratified sample. Total number of charr counted were: Ekalluk River, 183 203; Jayco River, 138 795; Halovik River, 21 214; Lauchlan River, 10 850.

Key words: counting fence; weir; statistical sampling; enumeration; stock assessment.

RÉSUMÉ

McGowan, D.K. 1990. Enumeration and biological data from the upstream migration of Arctic charr, Salvelinus alpinus (L.), in the Cambridge Bay area, Nortwest Territories, 1979-1983. Can. Data Rep. Fish. Aquat. Sci. 811: iv + 27

En 1978, un programme d'identification et de dénombrement des stocks a été entrepris dans la région de la baie Cambridge. Une bordigue, ou clôture de dénombrement, a été utilisée pour mesurer la montaison de l'omble chevalier dans quatre rivières faisant l'objet d'une pêche commerciale. On présente un sommaire des données relatives au nombre d'ombles dénombrés, marqués et échantillonnés vivants, les données biologiques obtenues et les données relatives à la chronologie des migrations. Parmi les données biologiques prélevées figurent les caractéristiques de longueur, de poids, d'âge et de maturité d'échantillons stratifiés. Le nombre total d'ombles dénombrés pour les quatre rivières sont les suivants: rivière Ekalluk, 183 203; rivière Jayco, 138 795; rivière Halovik, 21 214; rivière Lauchlan, 10 850.

Mots-clés: clôture de dénombrement; bordigue; échantillonnage statistique; dénombrement; évaluation des stocks.

INTRODUCTION

The largest commercial fishery for Arctic charr in the Northwest Territories is located at Cambridge Bay (Fig. 1) (Kristofferson et al. 1982). Since 1971 the Department of Fisheries and Oceans (DFO) has monitored this commercial fishery for Arctic charr (Kristofferson and Carder 1980; Carder 1981; Carder 1983; Carder and Low 1985; Carder 1988; Carder and Stewart 1989). Samples from the commercially fished populations are taken each year at the fish plant. Fork length and dressed weight are recorded and otoliths are removed for aging purposes.

In 1978 a stock assessment program was initiated. Objectives were to identify separate charr stocks, to determine the size of the migrating component of each stock and to determine the relative contribution of each stock to the commercial fishery (Kristofferson et al. 1984). Fish weirs were used to enumerate the upstream migration on the Ekalluk River (local name - Wellinton Bay) in 1979, the Jayco River in 1980 and 1981, the Halovik River (local name- 30-Mile) in 1981 and the Lauchlan River (local name - Byron Bay) in 1983. This report presents the data collected from these four rivers. The Paliryuak (local name - Surrey), Ellice and Perry Rivers have not been assessed to date.

MATERIALS AND METHODS

WEIR SITE SELECTION

The depth of the water, velocity and bottom type were the main considerations when selecting a site for the weir. The water depth choosen was 30 - 45 cm less than the height of the fence to allow for storm surges. The velocity was dependant on the depth of the water. If walking in the river with chest waders was relatively easy then construction was possible. A bottom relatively stable and free of large boulders was choosen. In large rivers like the Ekalluk (over 75 metres in width) more than one trap was required in the fence. A nearby suitable landing site for float-equipped aircraft was also considered when a site was selected. The width of a river was not a factor other than wide rivers requiring more material.

WEIR CONSTRUCTION

The design and construction of the weirs used on the Jayco River in 1980 and 1981 are described in detail in Kristofferson et al. (1986). A description of materials and the construction of the weir design used on the other rivers follows.

Materials

Fence material consisted of 25 mm x 25 mm welded wire mesh 1.5 m high, stapled to 51 mm x 102 mm (2X4) wooden stringers leaving a 0.5 m overhang of wire on one end only. These formed panels 4.9 m (16 ft) long by 1.2 m (4 ft) high with a 0.3 m (1 ft) skirting. A-frames of varying height (depending on water depth) were constructed from 51 mm x 102 mm lumber. The A-frames were nailed to the panels in the middle and at the end without the overhang.

The trap 1.2 m (4 ft) x 2.4 m (8 ft) x 1.5 m (5 ft) high was constructed of individual panels using 51 mm x 102 mm lumber and 13 mm x 13 mm (0.5 in x 0.5 in) wire mesh stapled to the frames. The individual panels were bolted together on a 16 mm (5/8 in) thick floor prior to placement in the water. The entrance to the trap was formed by placing two panels at an angle to provide a vertical opening 153 mm (6 in) in width. A sliding 13 mm thick plywood door 200 mm (8 in) x 2.4 m (8 ft) controlled access to the trap. Two vertical sliding panels in the back of the trap could be removed for handling or passage of fish as necessary.

Construction

The trap was place in the water and secured with rock bags and T-rail posts. The area chosen had sufficient water depth to allow working comfortably inside the trap in chest waders. The wings were then positioned next to the trap starting from the trap and working toward shore. The beginning of the first wing was nailed to the trap and the A-frames secured with rock bags. Rocks were placed on the skirting to secure the bottom of the wings. The next wing was nailed to the end of the first wing and secured. The overhang of wire on the end of the wings were secured to the trap and the last wing using electrical ty-raps. This overhang of wire sealed any openings between the wing panels.

BIOLOGICAL DATA

At the beginning of the migration checks were done two or three times a day and as the numbers of migrants increased, checks were made five or six times a day. During the peak of the migration when large numbers of charr were moving, a glass-bottomed viewer was placed in the trap next to the front sliding door. As the fish passed under the viewer, they were counted using hand tally counters. The number of fish entering the trap was controlled by raising or lowering the door.

Each day, 100-150 charr were randomly selected from the trap and sampled for fork length (±1 mm), and round weight (±50 g). Fish

over 450 mm were tagged with floy (spaghetti) tags. All fish were then released. The two samples (tagged and live) were combined for all biological analyzes. The number of charr in the trap at the time of sampling varied between 100-800 depending on the length of time the downstream trap door was left open.

A sample of charr, stratified by length, was sacrificed to estimate the age-length relationship. Approximately ten charr from each 50 mm length interval were sampled during the migration. Fork length (±1 mm), round weight (±50 g), sex and stage of maturity (Appendix 1) were noted and the sagittal otoliths were removed for aging purposes. Aging was conducted as described by Kristofferson et al. (1982).

The relative condition factor (K), a measure of the "robustness" of the fish, was determined by the formula:

$$K = \frac{Wx10^5}{L^3}$$

where W = weight in grams
and L = length in mm

DATA ANALYSIS

Data were analyzed using computer facilities (Micro Vax II) at the Freshwater Institute. The Statistical Analysis System (1985) was used to generate length, weight, age, and sex and maturity summaries. The graphs representing the daily number of enumerated charr were produced on an IBM compatible PC computer using Sigma Plot software version 4.0. The maps were produced on an IBM compatible PC using Corel Draw software version 1.1.

RESULTS

Table 1 summarizes the number of Arctic charr tagged, live sampled and counted, the biological data collected and the timing of the migration for each river monitored. The biological data by length interval for Arctic charr live sampled and tagged at each river are shown in Tables 2 - 6. Biological data by age group and length interval from the sacrificed sample of Arctic charr stratified by length are shown in Tables 7 - 16. Age data are not considered representative of the populations as the samples are stratified by length. Figures 6 -10 graphically represent the daily number of Arctic charr enumerated at each river.

ACKNOWLEDGMENTS

The author extends thanks to the Cambridge Bay commercial fishermen and the staff of the Ikaluktiak Co-operative particularly William and Jesse Lyall for their assistance and co-operation.

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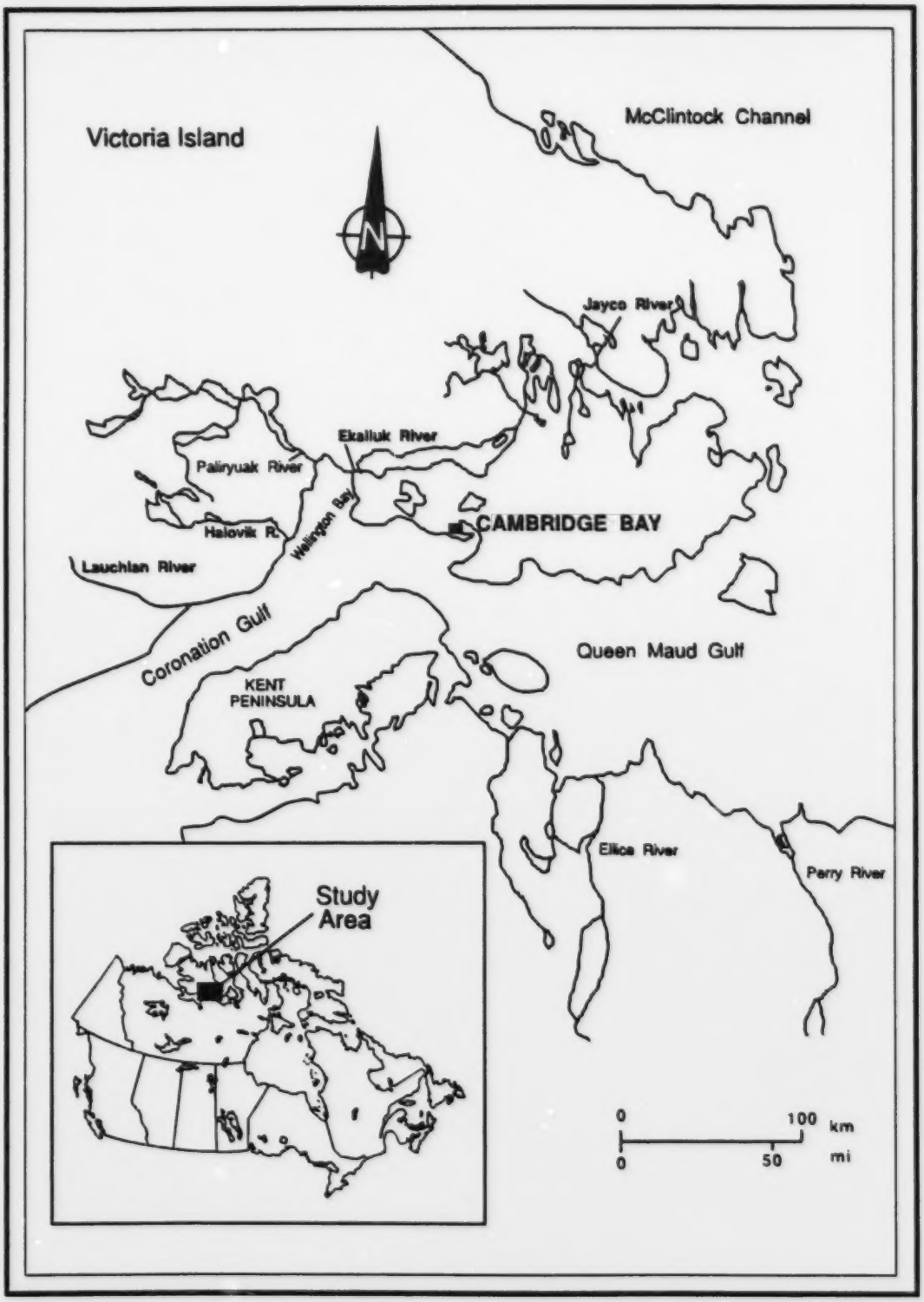

Fig. 1. Map of the Cambridge Bay area showing the commercially fished rivers.

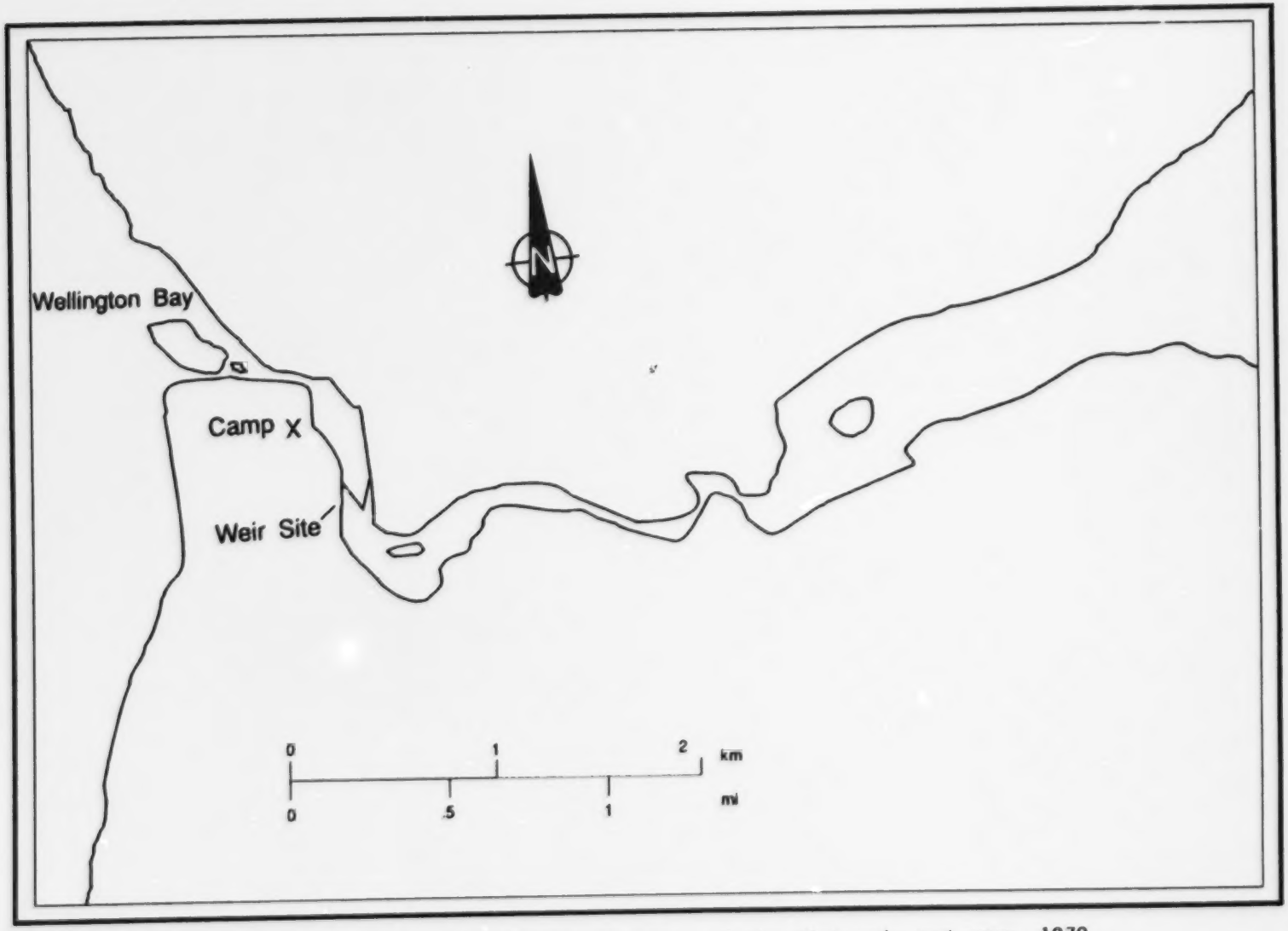

Fig. 2. Map of the Ekalluk River showing the location of the fish weir and camp, 1979.

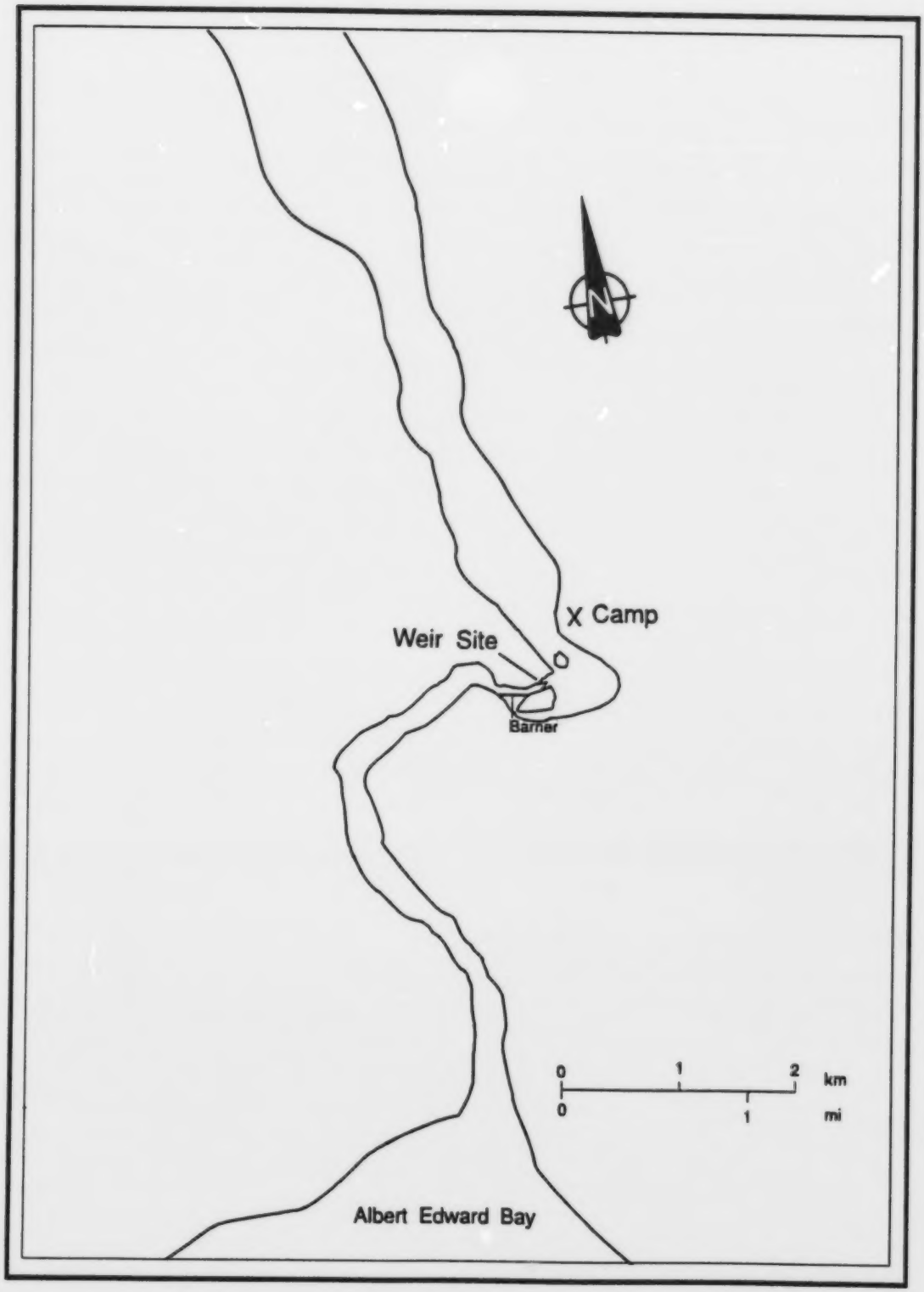

Fig. 3. Map of the Jayco River showing the location of the fish weir and camp, 1980 and 1981.

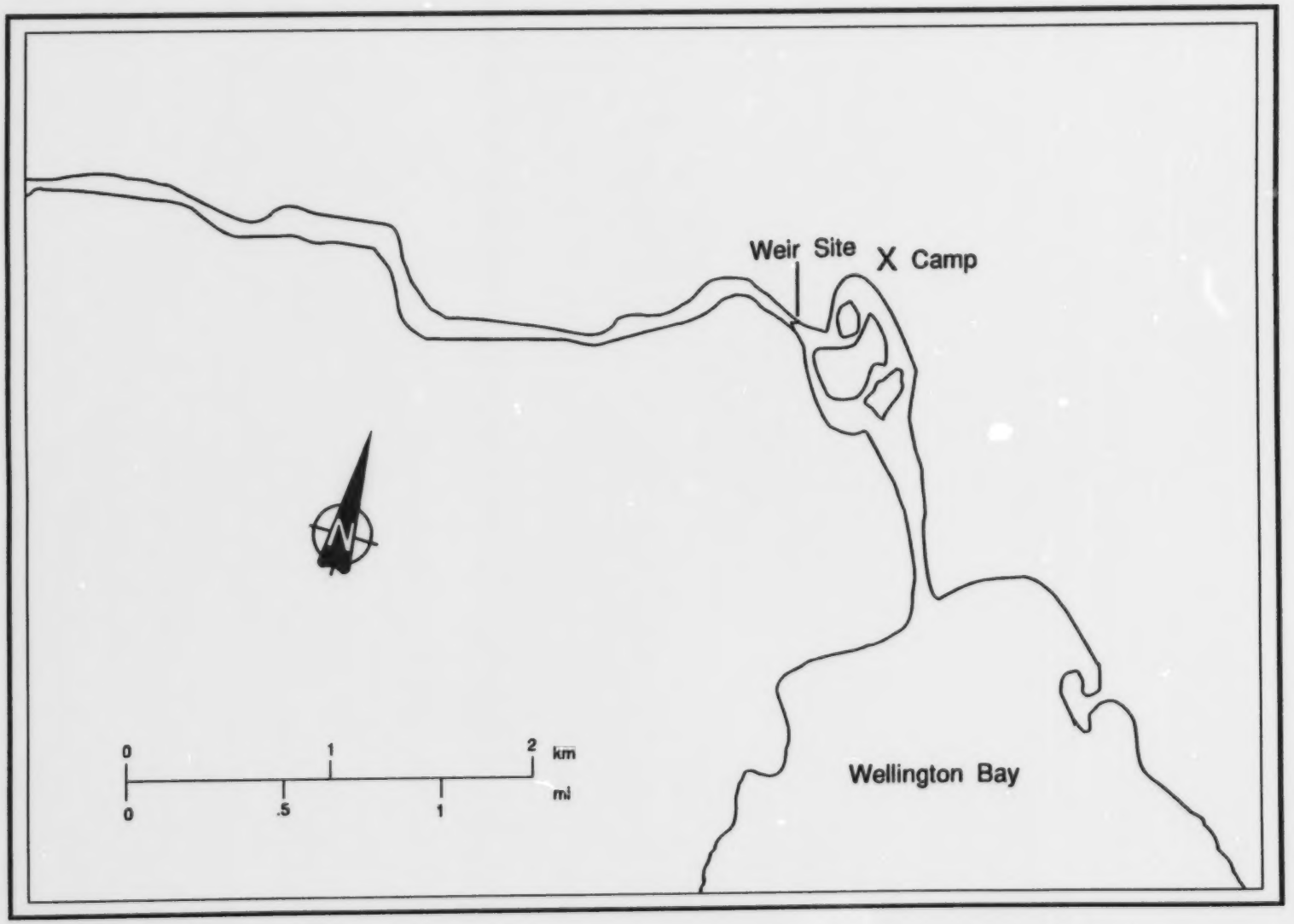

Fig. 4. Map of the Halovik River showing the location of the fish weir and camp, 1981.

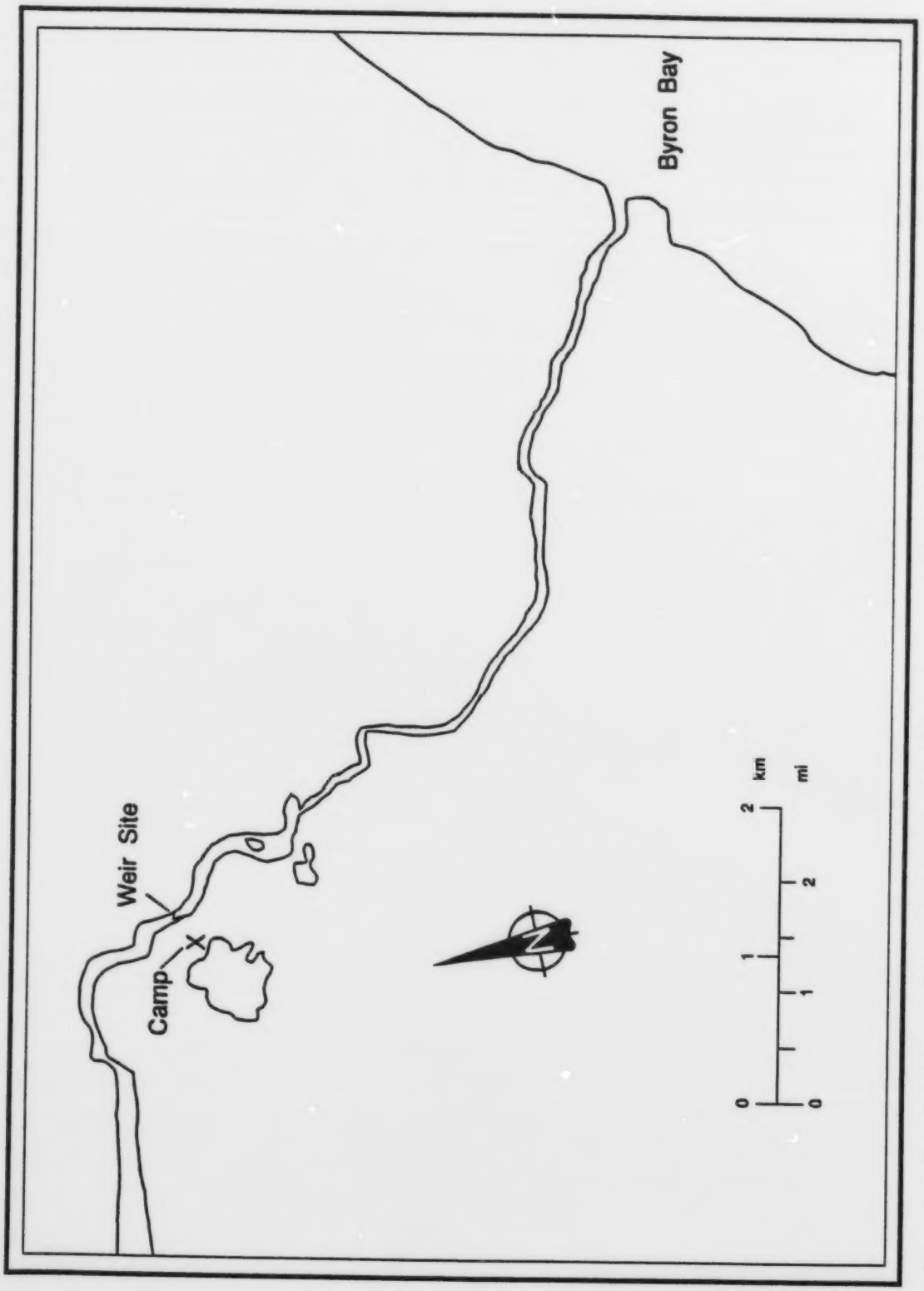

Fig. 5. Map of the Lauchlan River showing the location of the fish weir and camp, 1983.

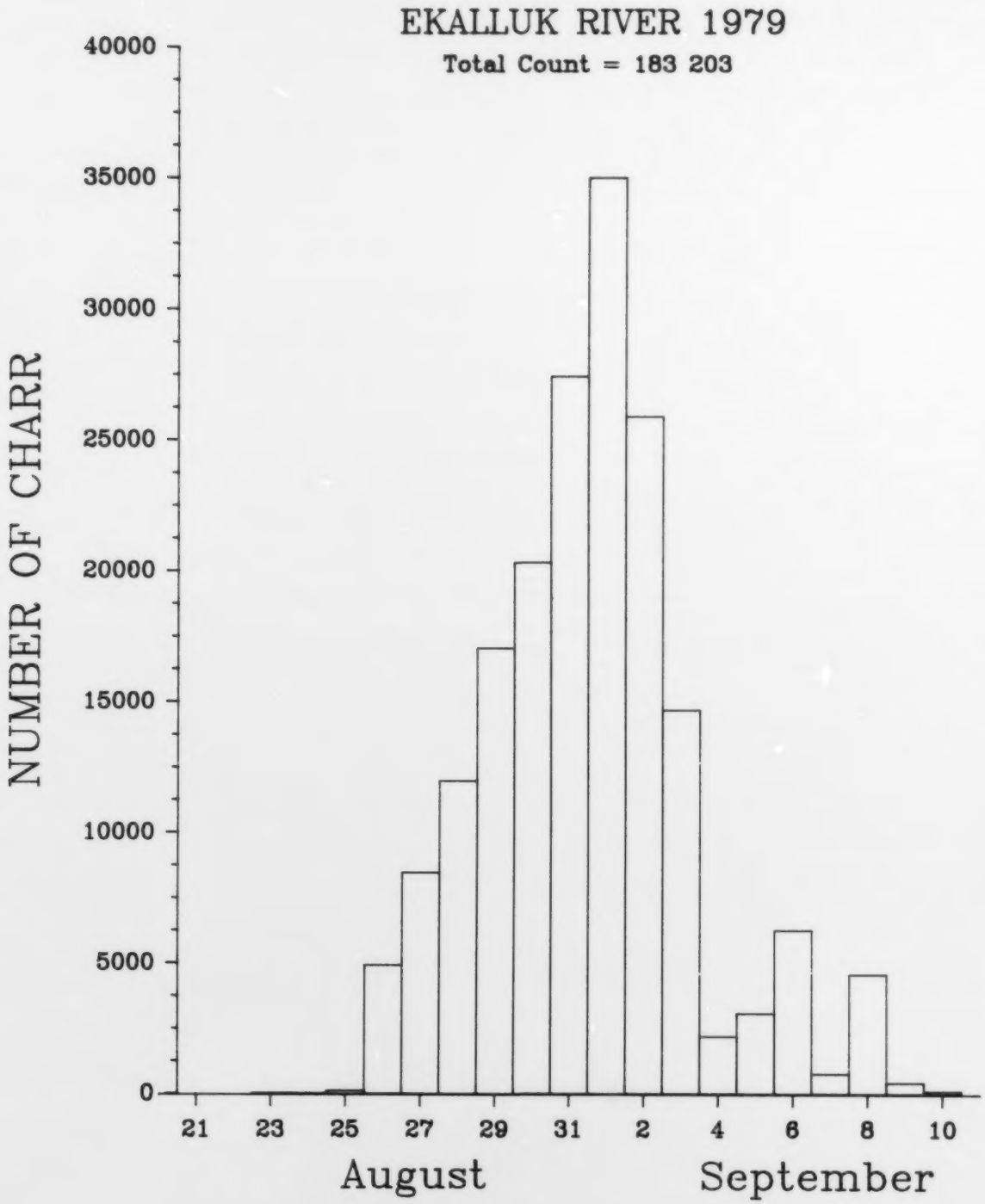

Fig. 6. Daily counts of Arctic charr migrating upstream through the fish weir, Ekalluk River, 1979.

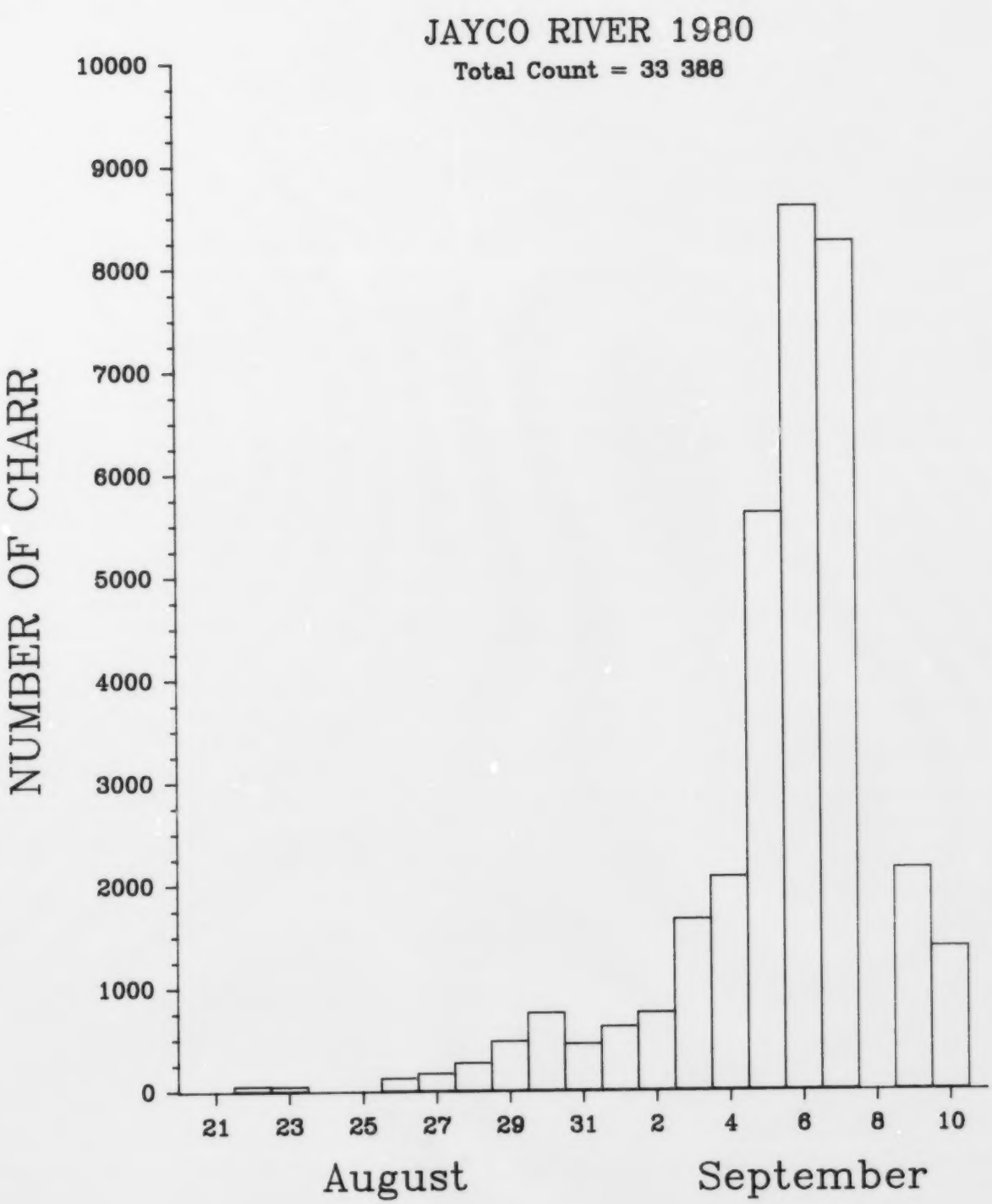

Fig. 7. Daily counts of Arctic charr migrating upstream through the fish weir, Jayco River, 1980.

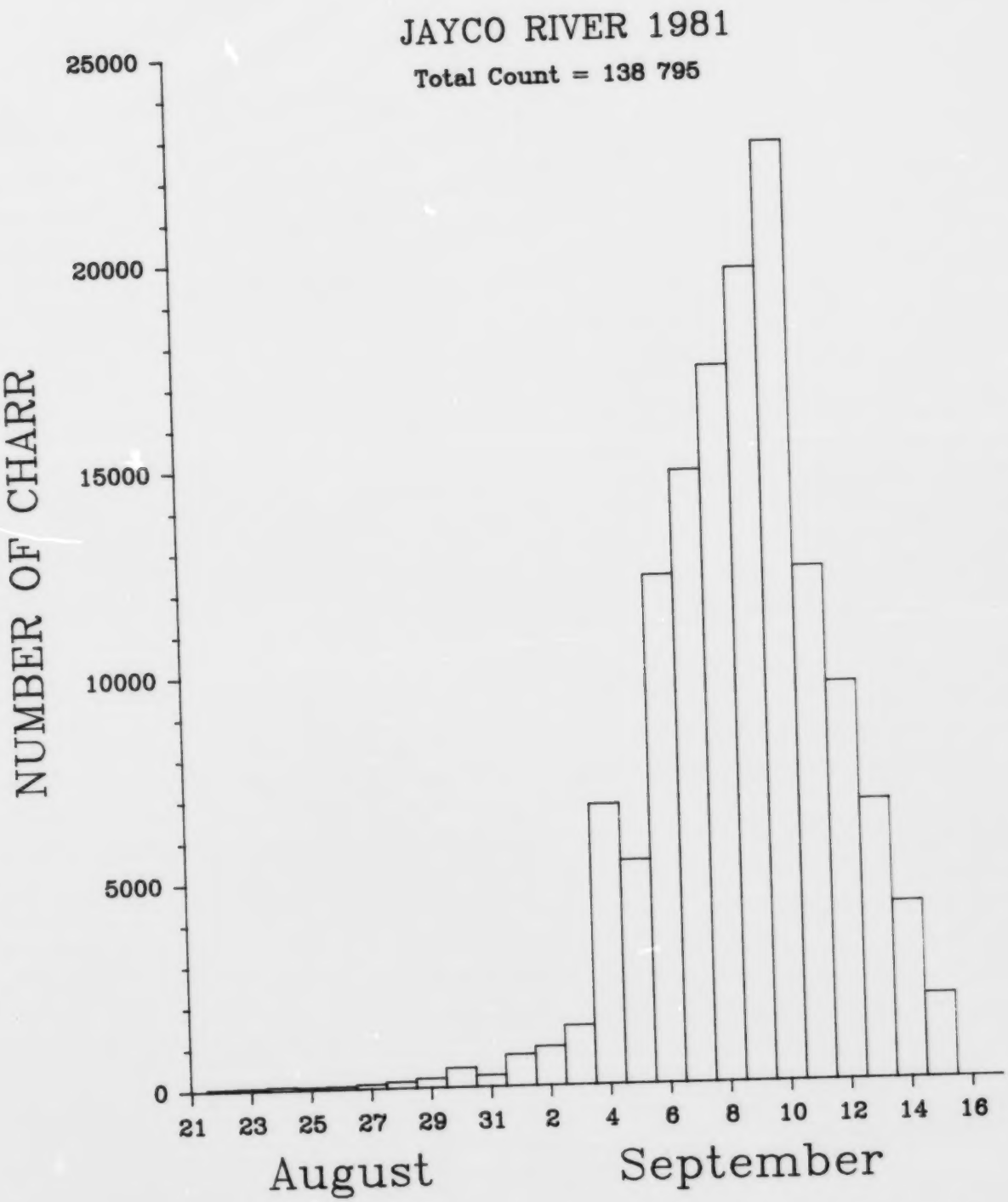

Fig. 8. Daily counts of Arctic charr migrating upstream through the fish weir, Jayco River, 1981.

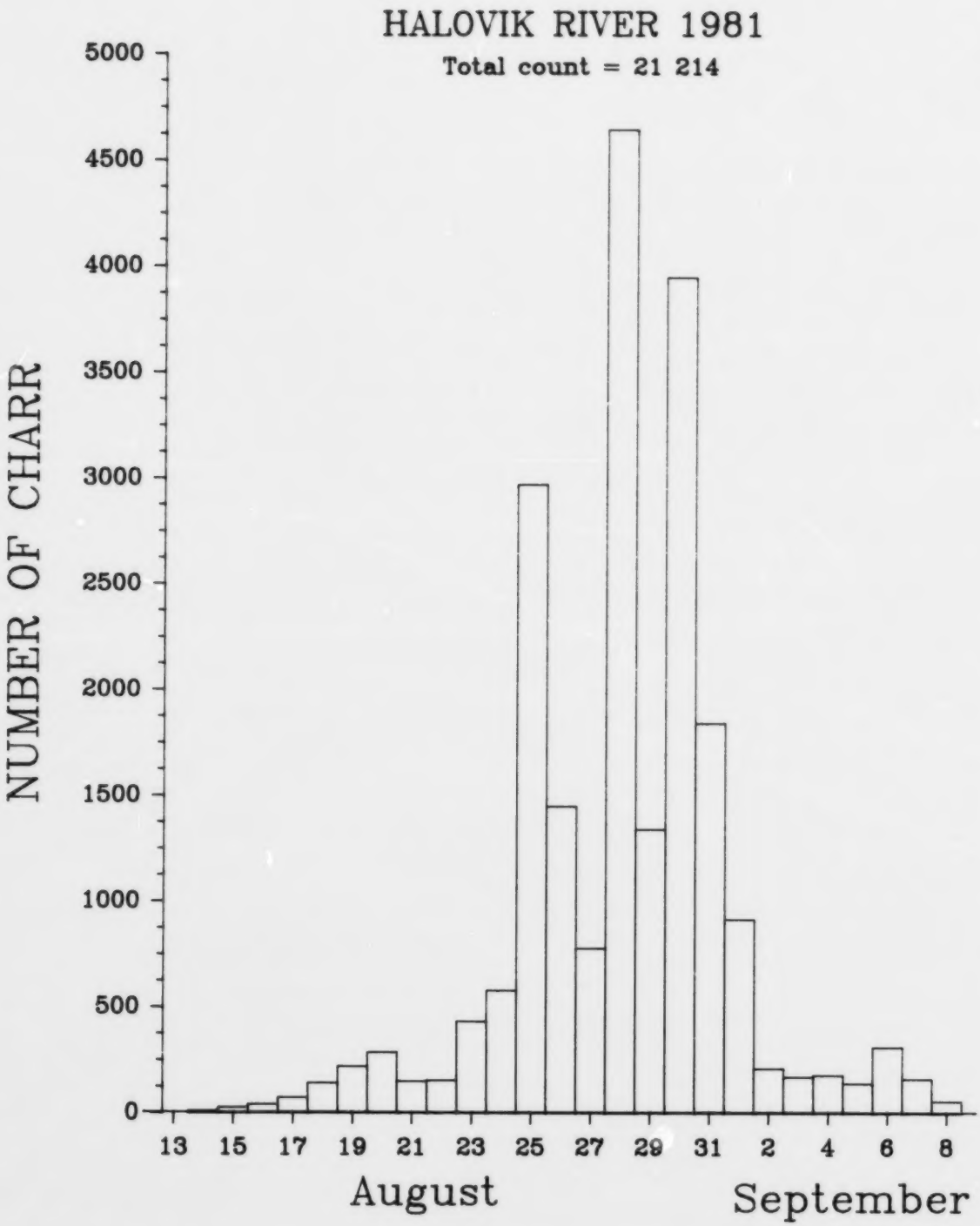

Fig. 9. Daily counts of Arctic charr migrating upstream through the fish weir, Halovik River, 1981.

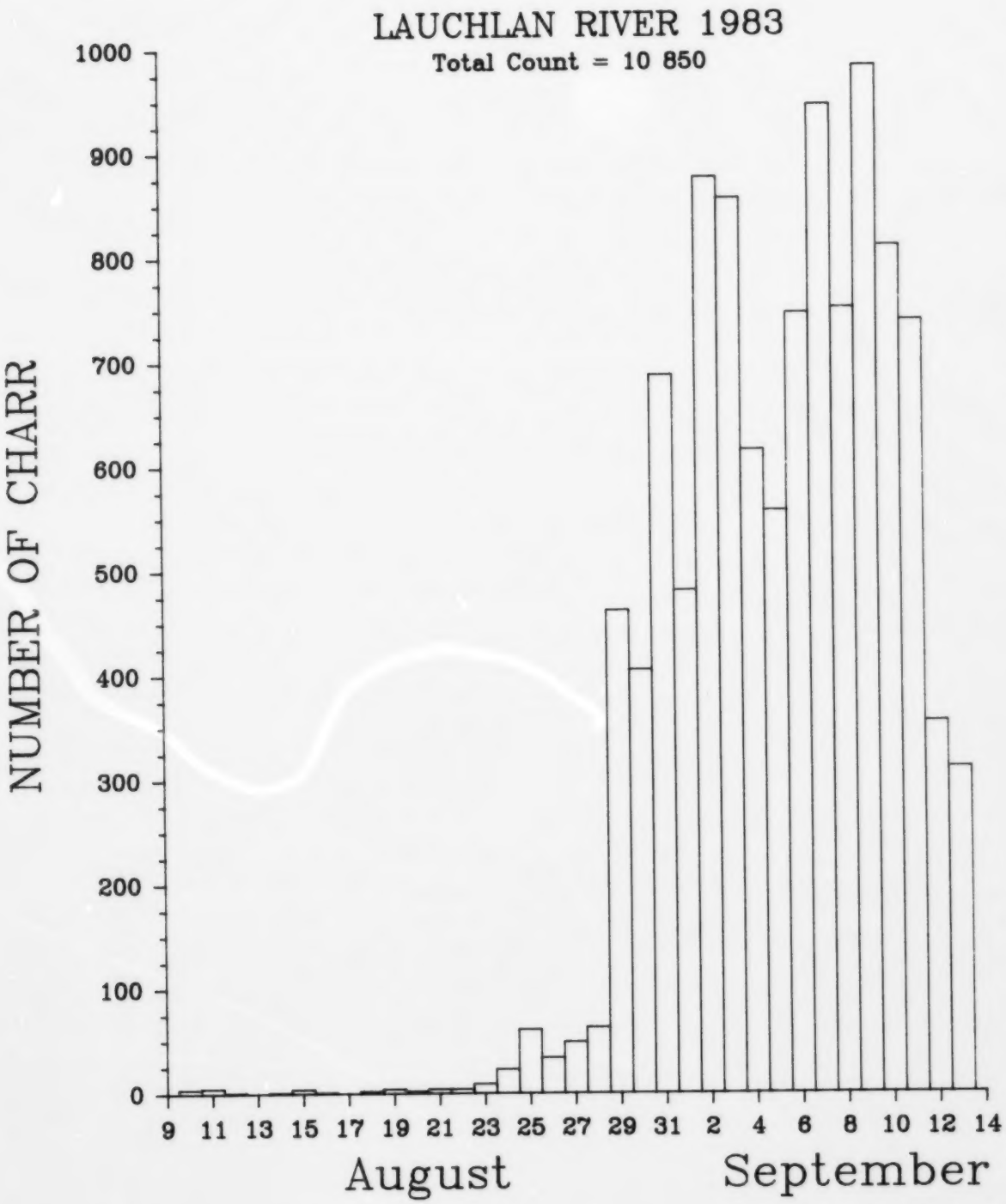

Fig. 10. Daily counts of Arctic charr migrating upstream through the fish weir, Lauchlan River 1983.

Table 1. Summary of the number of Arctic charr tagged, live sampled and counted, the biological data collected and the timing of the migrations at four rivers in the Cambridge Bay area.

Summary	Ekalluk R. 1979	Jayco R. 1980	Jayco R. 1981	Halovik R. 1981	Lauchlan R. 1983
Timing	20 Aug. to 10 Sept.	22 Aug. to 10 Sept.	22 Aug. to 15 Sept.	13 Aug. to 8 Sept.	10 Aug. to 13 Sept.
Tagged	993	830	945	996	995
Live Sampled	979	942	2317	1532	1435
Sacrificed Sample	152	115	210	124	141
Total Sampled	2124	1887	3472	2652	2571
Total Counted	183 203	33 388	138 795	21 214	10 850
Modal Length (mm)	600	450	500	650	650
Mean Length (mm)	539	536	532	574	585
Mean Weight (g)	2084	1932	2125	3017	2948
Mean K-Factor	1.18	1.14	1.30	1.37	1.31

Table 2. Biological data by length interval for Arctic charr live sampled and tagged at the Ekalluk River fish weir 20 August - 10 September 1979.

LENGTH INTERVAL (MM)	NO.	PERCENT	MEAN FORK LENGTH(MM)	ROUND WEIGHT(G) MEAN	ROUND WEIGHT(G) SD	K
200	4	0	226	100	0	0.86
250	18	1	280	242	43	1.10
300	76	4	330	407	97	1.12
350	165	8	377	597	122	1.11
400	204	10	428	938	183	1.19
450	239	12	474	1271	195	1.19
500	287	15	525	1733	222	1.20
550	311	16	574	2273	328	1.20
600	334	17	625	2909	418	1.19
650	231	12	670	3594	470	1.19
700	72	4	721	4338	581	1.16
750	27	1	768	5159	649	1.14
800	4	0	812	5813	399	1.09
TOTAL	1972					
MEAN			539	2084	1185	1.18

Table 3. Biological data by length interval for Arctic charr live sampled and tagged at the Halovik River fish weir 13 August - 8 September 1981.

LENGTH INTERVAL (MM)	NO.	PERCENT	MEAN FORK LENGTH(MM)	ROUND WEIGHT(G) MEAN	ROUND WEIGHT(G) SD	K
200	13	1	237	142	53	1.06
250	48	2	277	235	53	1.11
300	84	3	332	415	96	1.13
350	174	7	378	616	118	1.13
400	173	7	423	930	177	1.22
450	150	6	477	1480	278	1.36
500	246	10	528	2080	320	1.41
550	360	14	574	2704	387	1.43
600	426	17	626	3571	472	1.46
650	528	21	674	4399	511	1.43
700	271	11	720	5252	564	1.41
750	54	2	762	6095	705	1.38
800	1	0	800	6650	-	1.30
TOTAL	2528					
MEAN			574	3017	1649	1.37

Table 4. Biological data by length interval for Arctic charr live sampled and tagged at the Jayco River fish weir 22 August - 10 September 1980.

LENGTH INTERVAL (MM)	NO.	PERCENT	MEAN FORK LENGTH(MM)	ROUND WEIGHT(G) MEAN	SD	K
250	1	0	253	100	-	0.62
300	11	1	336	427	93	1.12
350	123	7	383	643	131	1.15
400	250	14	425	888	174	1.15
450	314	18	476	1236	183	1.14
500	303	17	525	1628	264	1.13
550	273	15	574	2191	376	1.16
600	235	13	625	2796	472	1.14
650	171	10	671	3500	550	1.16
700	75	4	717	4105	716	1.11
750	16	1	760	4656	673	1.06
TOTAL	1772					
MEAN			536	1932	1063	1.14

Table 5. Biological data by length interval for Arctic charr live sampled and tagged at the Jayco River fish weir 22 August - 15 September 1981.

LENGTH INTERVAL (MM)	NO.	PERCENT	MEAN FORK LENGTH(MM)	ROUND WEIGHT(G) MEAN	SD	K
200	6	0	235	196	40	1.56
250	11	0	272	366	346	1.84
300	15	0	337	603	356	1.59
350	82	3	382	680	180	1.21
400	429	13	428	986	254	1.25
450	674	21	475	1345	259	1.25
500	678	21	523	1854	418	1.29
550	644	20	573	2512	522	1.33
600	409	13	621	3234	550	1.35
650	238	7	670	4073	711	1.35
700	65	2	716	4718	932	1.29
750	10	0	766	5370	1257	1.19
800	1	0	808	5100	-	0.97
TOTAL	3262					
MEAN			532	2125	1110	1.30

Table 6. Biological data by length interval for Arctic charr live sampled and tagged at the Lauchlan River fish weir 10 August - 13 September 1983.

LENGTH INTERVAL (MM)	NO.	PERCENT	MEAN FORK LENGTH(MM)	ROUND WEIGHT(G) MEAN	ROUND WEIGHT(G) SD	K
250	8	0	276	238	52	1.13
300	38	2	331	474	136	1.32
350	112	5	375	689	165	1.31
400	168	7	427	1036	385	1.33
450	326	13	475	1352	216	1.26
500	268	11	523	1818	340	1.27
550	320	13	574	2446	366	1.29
600	367	15	626	3262	405	1.33
650	367	15	674	4108	482	1.34
700	290	12	721	5057	566	1.35
750	136	6	769	5907	715	1.30
800	30	1	812	6920	645	1.29
TOTAL	2430					
MEAN			585	2948	1655	1.31

Table 7. Biological data by age group from the sacrificed sample of Arctic charr stratified by length, Ekalluk River fish weir 20 August - 10 September 1979.

AGE (YR)	MALES							FEMALES							COMBINED						
	N	LENGTH(MM) MEAN	SD	WEIGHT(G) MEAN	SD	K	% MAT	N	LENGTH(MM) MEAN	SD	WEIGHT(G) MEAN	SD	K	% MAT	N	LENGTH(MM) MEAN	SD	WEIGHT(G) MEAN	SD	K	% MAT
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	194	-	50	-	0.68	100
5	2	239	44	150	71	1.06	0	1	223	-	75	-	0.68	0	21	232	30	137	74	1.04	33
6	1	349	-	450	-	1.06	0	1	323	-	350	-	1.04	0	9	251	51	192	125	1.09	22
7	2	335	3	375	35	1.00	0	1	378	-	550	-	1.02	0	10	300	49	293	125	1.04	30
8	-	-	-	-	-	-	-	1	310	-	350	-	1.17	0	4	288	59	275	150	1.07	0
9	3	352	31	450	132	1.01	0	4	381	36	638	193	1.12	25	10	358	38	493	197	1.01	20
10	3	424	19	817	161	1.06	0	5	492	53	1280	327	1.07	0	9	458	57	1044	380	1.05	0
11	5	557	53	1810	485	1.02	20	5	459	66	1080	480	1.06	0	12	484	89	1279	664	1.03	8
12	6	639	104	3225	1568	1.16	67	3	559	48	2083	645	1.17	33	10	608	90	2760	1349	1.15	56
13	4	680	63	3663	981	1.15	75	4	593	26	2163	350	1.04	0	8	636	65	2913	1052	1.09	38
14	4	657	92	3388	1413	1.12	100	3	661	82	3250	976	1.11	67	8	652	77	3225	1104	1.12	88
15	4	714	60	4338	898	1.18	100	4	711	51	4113	914	1.13	100	8	713	52	4225	847	1.16	100
16	3	790	45	5450	1143	1.10	100	3	676	58	3567	778	1.14	67	6	733	78	4508	1353	1.12	83
17	3	743	55	4633	983	1.12	100	3	687	7	3600	346	1.11	100	6	715	47	4117	869	1.11	100
18	4	818	14	6025	247	1.10	100	3	683	66	3867	929	1.20	67	7	760	82	5100	1284	1.14	86
19	1	672	-	3150	-	1.04	100	1	695	-	3900	-	1.16	100	2	684	16	3525	530	1.10	100
20	1	780	-	5050	-	1.06	100	-	-	-	-	-	-	-	1	780	-	5050	-	1.06	100
TOTAL	46							42							132						

Table 8. Biological data by length interval from the sacrificed sample of Arctic charr stratified by length, Ekalluk River fish weir 20 August - 10 September 1979.

LENGTH INTERVAL (MM)	MALES						FEMALES						COMBINED					
		LENGTH(MM)	WEIGHT(G)			%		LENGTH(MM)	WEIGHT(G)			%		LENGTH(MM)	WEIGHT(G)			%
	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT
150	-	-	-	-	-	-	-	-	-	-	-	-	2	195	75	35	1.02	50
200	1	208	100	-	1.11	0	1	223	75	-	0.68	0	30	222	116	27	1.05	37
250	2	280	225	35	1.02	0	-	-	-	-	-	-	9	271	211	42	1.06	11
300	4	334	375	65	1.00	0	4	331	400	71	1.10	0	13	328	360	72	1.01	15
350	2	370	525	35	1.04	0	4	382	600	129	1.07	0	11	374	532	98	1.01	9
400	3	424	817	161	1.06	0	3	422	817	104	1.08	33	6	423	817	121	1.07	17
450	3	481	1317	275	1.17	0	4	465	1125	29	1.12	0	7	472	1207	190	1.14	0
500	2	530	1625	318	1.09	50	2	523	1650	141	1.16	0	4	526	1638	202	1.12	25
550	4	574	1925	65	1.02	25	7	568	1986	372	1.08	0	12	570	1967	278	1.06	8
600	5	619	2730	280	1.15	60	6	615	2633	325	1.13	33	12	616	2663	285	1.14	50
650	4	679	3388	160	1.08	100	10	681	3510	280	1.11	90	14	680	3475	252	1.10	93
700	10	724	4370	494	1.15	90	3	725	4317	126	1.13	100	13	724	4358	431	1.15	92
750	8	778	5144	481	1.09	100	3	770	5100	180	1.12	100	11	775	5132	411	1.10	100
800	7	826	6293	407	1.11	100	-	-	-	-	-	-	7	826	6293	407	1.11	100
850	1	850	4250	-	0.69	0	-	-	-	-	-	-	1	850	4250	-	0.69	0
TOTAL	56						47						152					

Table 9. Biological data by age group from the sacrificed sample of Arctic charr stratified by length, Halovik River fish weir 13 August - 8 September 1981.

AGE (YR)	MALES							FEMALES							COMBINED						
	N	LENGTH(MM) MEAN	SD	WEIGHT(G) MEAN	SD	K	% MAT	N	LENGTH(MM) MEAN	SD	WEIGHT(G) MEAN	SD	K	% MAT	N	LENGTH(MM) MEAN	SD	WEIGHT(G) MEAN	SD	K	% MAT
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	251	-	200	-	1.26	-
5	2	387	49	700	283	1.18	0	1	309	-	300	-	1.02	0	8	292	67	319	270	1.04	0
6	-	-	-	-	-	-	-	5	296	26	300	94	1.13	0	8	294	20	288	74	1.11	0
7	4	360	23	550	122	1.17	0	3	370	29	583	176	1.12	0	10	340	47	480	184	1.15	0
8	1	477	-	1300	-	1.20	0	-	-	-	-	-	-	-	2	370	151	750	778	1.15	0
9	2	479	4	1250	71	1.14	0	7	437	61	1093	453	1.23	0	10	432	70	1045	459	1.19	0
10	2	371	52	625	318	1.17	0	6	455	52	1225	466	1.26	0	8	434	62	1075	496	1.23	0
11	6	484	108	1564	1128	1.20	0	5	487	82	1540	890	1.19	0	11	485	92	1553	976	1.19	0
12	4	520	140	2113	1392	1.26	25	5	573	34	2480	599	1.29	40	9	550	93	2317	971	1.28	33
13	5	493	111	2000	1600	1.35	0	6	595	137	3058	1727	1.23	33	11	549	131	2577	1679	1.28	18
14	3	655	40	4083	794	1.44	67	8	593	105	3069	1596	1.34	38	11	610	94	3345	1460	1.37	45
15	2	607	24	2850	354	1.27	50	-	-	-	-	-	-	-	2	607	24	2850	354	1.27	50
16	1	675	-	4100	-	1.33	0	1	637	-	3200	-	1.24	100	2	656	27	3650	636	1.29	50
17	-	-	-	-	-	-	-	1	732	-	5400	-	1.38	100	1	732	-	5400	-	1.38	100
TOTAL	32							48							94						

Table 10. Biological data by length interval from the sacrificed sample of Arctic charr stratified by length, Halovik River fish weir 13 August - 8 September 1981.

LENGTH INTERVAL (MM)	MALES						FEMALES						COMBINED					
		LENGTH(MM)	WEIGHT(G)			%		LENGTH(MM)	WEIGHT(G)			%		LENGTH(MM)	WEIGHT(G)			%
	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT
200	-	-	-	-	-	-	-	-	-	-	-	-	4	237	125	50	0.91	0
250	-	-	-	-	-	-	6	288	258	38	1.08	0	14	283	254	37	1.12	0
300	3	332	400	0	1.09	0	4	330	388	63	1.07	0	10	325	380	48	1.10	0
350	6	372	592	86	1.15	0	5	380	630	140	1.13	0	11	375	609	109	1.14	0
400	7	417	843	84	1.17	0	9	425	939	158	1.21	0	16	422	897	136	1.19	0
450	4	481	1338	149	1.20	0	6	484	1417	181	1.24	0	10	483	1385	165	1.23	0
500	2	526	1925	318	1.32	0	8	529	1863	215	1.26	13	10	528	1875	219	1.27	10
550	7	577	2508	227	1.31	29	6	573	2692	622	1.42	17	13	575	2593	443	1.36	23
600	6	628	3455	524	1.40	33	4	616	3125	132	1.34	50	10	623	3323	433	1.37	40
650	5	668	3778	303	1.27	20	10	666	3818	471	1.30	60	14	667	3830	415	1.29	50
700	3	713	5000	0	1.38	67	8	712	4574	1263	1.27	75	11	712	4690	1075	1.30	73
800	1	810	6750	-	1.27	100	-	-	-	-	-	-	1	810	6750	-	1.27	100
TOTAL	44						66						124					

Table 11. Biological data by age group from the sacrificed sample of Arctic charr stratified by length, Jayco River fish weir 22 August - 10 September 1980.

AGE (YR)	MALES N	MALES LENGTH(MM) MEAN	MALES LENGTH(MM) SD	MALES WEIGHT(G) MEAN	MALES WEIGHT(G) SD	MALES K	MALES % MAT	FEMALES N	FEMALES LENGTH(MM) MEAN	FEMALES LENGTH(MM) SD	FEMALES WEIGHT(G) MEAN	FEMALES WEIGHT(G) SD	FEMALES K	FEMALES % MAT	COMBINED N	COMBINED LENGTH(MM) MEAN	COMBINED LENGTH(MM) SD	COMBINED WEIGHT(G) MEAN	COMBINED WEIGHT(G) SD	COMBINED K	COMBINED % MAT
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	225	-	150	-	1.32	0
6	1	356	-	500	-	1.11	0	1	240	-	100	-	0.72	0	12	249	35	179	105	1.10	0
8	-	-	-	-	-	-	-	1	385	-	625	-	1.10	0	1	385	-	625	-	1.10	0
9	1	392	-	650	-	1.08	0	1	356	-	475	-	1.05	0	2	374	25	563	124	1.07	0
10	5	442	29	1000	213	1.15	0	3	427	11	875	125	1.12	0	8	436	24	953	186	1.14	0
11	9	460	30	1072	221	1.08	0	6	396	29	717	160	1.14	0	16	431	44	909	268	1.10	0
12	4	550	101	1950	1015	1.11	0	4	471	30	1200	235	1.14	0	8	511	81	1575	791	1.12	0
13	6	525	48	1571	388	1.08	0	1	663	-	3050	-	1.05	100	7	544	68	1782	662	1.08	14
14	7	564	80	1979	829	1.07	14	2	554	52	1700	212	1.01	0	9	562	72	1917	732	1.06	11
15	4	594	77	2213	873	1.01	50	4	574	32	1994	77	1.06	25	8	584	55	2103	586	1.04	38
16	2	595	53	2025	35	0.98	0	-	-	-	-	-	-	-	2	595	53	2025	35	0.98	0
17	3	653	137	3067	1550	1.03	100	1	616	-	2250	-	0.96	100	4	644	114	2863	1330	1.01	100
18	2	682	25	3000	424	0.94	0	2	631	2	2750	212	1.10	100	4	656	33	2875	310	1.02	50
19	1	515	-	1200	-	0.88	0	-	-	-	-	-	-	-	1	515	-	1200	-	0.88	0
20	1	644	-	3000	-	1.12	0	-	-	-	-	-	-	-	1	644	-	3000	-	1.12	0
22	-	-	-	-	-	-	-	1	661	-	2050	-	0.71	100	1	661	-	2050	-	0.71	100
TOTAL	46							27							85						

Table 12. Biological data by length interval from the sacrificed sample of Arctic charr stratified by length, Jayco River fish weir 22 August - 10 September 1980.

LENGTH INTERVAL (MM)	MALES						FEMALES						COMBINED					
		LENGTH(MM)	WEIGHT(G)			%		LENGTH(MM)	WEIGHT(G)			%		LENGTH(MM)	WEIGHT(G)			%
	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT
200	-	-	-	-	-	-	1	240	100	-	0.72	0	12	237	140	25	1.06	0
250	-	-	-	-	-	-	-	-	-	-	-	-	2	251	188	18	1.19	0
350	4	385	681	138	1.18	0	6	376	600	91	1.12	0	11	380	630	107	1.14	0
400	7	430	882	126	1.10	0	7	434	918	97	1.12	0	14	432	900	110	1.11	0
450	14	478	1221	130	1.12	7	3	479	1267	104	1.15	0	17	478	1229	124	1.12	6
500	14	522	1521	177	1.07	14	3	522	1642	250	1.15	0	17	522	1543	188	1.08	12
550	11	569	1891	177	1.02	0	4	578	2025	194	1.05	25	15	572	1927	185	1.03	7
600	6	624	2346	479	0.96	17	4	624	2463	359	1.01	75	10	624	2393	417	0.98	40
650	4	673	3075	290	1.01	25	7	668	2671	450	0.89	86	11	669	2818	434	0.94	64
700	5	721	3650	391	0.97	80	1	738	3850	-	0.96	100	6	724	3683	359	0.97	83
TOTAL	65						36						115					

Table 13. Biological data by age group from the sacrificed sample of Arctic charr stratified by length, Jayco River fish weir 22 August - 15 September 1981.

AGE (YR)	MALES							FEMALES							COMBINED						
	N	LENGTH(MM) MEAN	SD	WEIGHT(G) MEAN	SD	K	% MAT	N	LENGTH(MM) MEAN	SD	WEIGHT(G) MEAN	SD	K	% MAT	N	LENGTH(MM) MEAN	SD	WEIGHT(G) MEAN	SD	K	% MAT
7	2	335	30	475	106	1.26	0	1	354	-	500	-	1.13	0	3	341	24	483	76	1.21	0
8	5	398	13	625	56	0.99	0	3	413	107	792	554	1.03	0	8	404	59	688	311	1.01	0
9	12	420	35	760	241	1.00	0	8	402	65	684	283	1.01	0	20	413	48	730	254	1.00	0
10	5	495	49	1275	482	1.01	20	11	445	39	848	245	0.94	0	16	461	47	981	379	0.96	6
11	8	503	59	1372	632	1.02	13	11	442	48	880	296	0.99	0	19	468	60	1087	516	1.00	5
12	10	521	60	1445	631	0.97	0	9	481	76	1167	523	0.99	11	19	502	69	1313	584	0.98	5
13	12	579	81	2283	1164	1.09	25	9	535	77	1811	970	1.08	22	21	560	80	2081	1086	1.09	24
14	12	612	93	2638	1378	1.04	8	4	528	114	1319	616	0.87	25	16	591	101	2308	1348	1.00	13
15	6	609	58	1946	897	0.91	33	8	539	71	1653	929	0.98	38	14	569	73	1779	892	0.95	36
16	8	595	85	2263	981	1.01	38	3	594	96	2183	808	1.03	67	11	595	83	2241	898	1.01	45
17	2	512	58	1550	566	1.13	50	-	-	-	-	-	-	-	2	512	58	1550	566	1.13	50
18	1	639	-	2600	-	1.00	100	1	713	-	2700	-	0.74	0	2	676	52	2650	71	0.87	50
19	2	688	74	3600	1131	1.09	0	-	-	-	-	-	-	-	2	688	74	3600	1131	1.09	0
20	1	650	-	3650	-	1.33	0	-	-	-	-	-	-	-	1	650	-	3650	-	1.33	0
21	1	647	-	3050	-	1.13	0	-	-	-	-	-	-	-	1	647	-	3050	-	1.13	0
25	1	819	-	4800	-	0.87	100	-	-	-	-	-	-	-	1	819	-	4800	-	0.87	100
TOTAL	88							68							156						

Table 14. Biological data by length interval from the sacrificed sample of Arctic charr stratified by length, Jayco River fish weir 22 August - 15 September 1981.

LENGTH	MALES						FEMALES						COMBINED					
INTERVAL		LENGTH(MM)	WEIGHT(G)			%		LENGTH(MM)	WEIGHT(G)			%		LENGTH(MM)	WEIGHT(G)			%
(MM)	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT
300	1	314	400	-	1.29	0	3	319	333	58	1.02	0	4	318	350	58	1.09	0
350	7	381	575	56	1.04	0	10	372	535	59	1.04	0	17	375	551	60	1.04	0
400	13	424	746	104	0.97	0	18	429	756	87	0.96	0	31	427	752	93	0.96	0
450	18	474	1050	150	0.98	17	23	472	1039	120	0.98	22	41	473	1044	132	0.98	20
500	17	523	1416	176	0.99	12	16	521	1408	152	1.00	31	33	522	1412	162	0.99	21
550	15	576	1993	285	1.04	20	10	577	1898	441	0.99	30	25	576	1955	350	1.02	24
600	16	629	2615	380	1.05	31	5	626	2590	472	1.05	40	21	628	2609	391	1.05	33
650	18	668	3254	907	1.09	17	4	669	3094	813	1.03	0	22	668	3225	874	1.08	14
700	9	722	4406	602	1.17	11	5	722	3240	399	0.86	80	14	722	3989	780	1.06	36
750	1	763	4100	-	0.92	0	-	-	-	-	-	-	1	763	4100	-	0.92	0
800	1	819	4800	-	0.87	100	-	-	-	-	-	-	1	819	4800	-	0.87	100
TOTAL	116						94						210					

Table 15. Biological data by age group from the sacrificed sample of Arctic charr stratified by length, Lauchlan River fish weir 10 August - 13 September 1983.

AGE (YR)	MALES N	MALES LENGTH(MM) MEAN	MALES LENGTH(MM) SD	MALES WEIGHT(G) MEAN	MALES WEIGHT(G) SD	MALES K	MALES % MAT	FEMALES N	FEMALES LENGTH(MM) MEAN	FEMALES LENGTH(MM) SD	FEMALES WEIGHT(G) MEAN	FEMALES WEIGHT(G) SD	FEMALES K	FEMALES % MAT	COMBINED N	COMBINED LENGTH(MM) MEAN	COMBINED LENGTH(MM) SD	COMBINED WEIGHT(G) MEAN	COMBINED WEIGHT(G) SD	COMBINED K	COMBINED % MAT
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	210	-	100	-	1.08	0
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	218	-	150	-	1.45	0
6	2	385	93	750	495	1.22	0	2	279	23	225	35	1.04	0	7	313	67	386	330	1.06	14
7	6	353	60	508	258	1.06	0	3	379	58	633	318	1.10	0	12	346	62	488	264	1.07	25
8	5	420	61	870	399	1.11	0	6	369	47	567	266	1.05	0	11	392	58	705	352	1.08	0
9	6	458	47	1100	303	1.12	0	6	427	77	917	470	1.08	0	14	425	74	907	441	1.08	7
10	2	431	95	950	707	1.06	0	9	443	49	1011	407	1.11	0	11	441	53	1000	428	1.10	0
11	5	492	34	1330	286	1.10	0	3	543	67	2033	889	1.21	0	8	511	51	1594	637	1.14	0
12	3	586	108	2467	1677	1.11	33	2	572	19	2100	212	1.12	0	5	580	77	2320	1208	1.11	20
13	8	649	62	3650	1373	1.28	75	9	573	76	2406	1151	1.20	11	17	608	78	2991	1378	1.23	41
14	12	656	104	3646	1874	1.18	75	6	623	85	3075	1209	1.21	67	18	645	97	3456	1667	1.19	72
15	6	742	73	5392	1517	1.28	100	8	680	73	4269	1355	1.30	88	14	707	77	4750	1485	1.29	93
16	7	769	57	5971	1322	1.30	100	1	624	-	3100	-	1.28	0	8	751	74	5613	1590	1.30	88
17	3	766	56	5317	936	1.18	100	3	737	85	5150	1262	1.28	100	6	752	66	5233	998	1.23	100
19	1	602	-	2500	-	1.15	0	1	718	-	5200	-	1.40	100	2	660	82	3850	1909	1.28	50
TOTAL	66							59							135						

Table 16. Biological data by length interval from the sacrificed sample of Arctic charr stratified by length, Lauchlan River fish weir 10 August - 13 September 1983.

LENGTH INTERVAL (MM)	MALES						FEMALES						COMBINED					
		LENGTH(MM)	WEIGHT(G)			%		LENGTH(MM)	WEIGHT(G)			%		LENGTH(MM)	WEIGHT(G)			%
	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT
200	-	-	-	-	-	-	-	-	-	-	-	-	3	223	133	29	1.20	0
250	2	280	225	35	1.02	0	2	279	225	35	1.04	0	9	275	211	33	1.01	44
300	2	334	450	71	1.20	0	5	332	370	76	1.00	0	9	333	389	70	1.05	0
350	5	374	530	76	1.01	0	5	370	560	119	1.10	0	12	370	529	96	1.04	17
400	5	418	840	114	1.14	0	7	424	829	99	1.08	0	12	422	833	101	1.11	0
450	9	477	1239	134	1.14	0	8	476	1219	46	1.13	0	17	477	1229	100	1.13	0
500	6	521	1517	121	1.08	0	8	525	1663	160	1.15	0	14	523	1600	158	1.12	0
550	7	577	2171	229	1.13	43	4	570	2088	125	1.13	0	11	574	2141	195	1.13	27
600	4	619	2788	379	1.17	75	9	626	3111	307	1.27	44	13	624	3012	351	1.24	54
650	5	674	4120	565	1.34	100	4	670	3888	419	1.29	100	9	672	4017	491	1.32	100
700	7	720	4650	258	1.25	100	7	726	5107	360	1.34	100	14	723	4879	383	1.29	100
750	9	776	6150	431	1.31	100	2	786	5875	177	1.21	100	11	778	6100	405	1.30	100
800	7	819	6657	642	1.21	100	-	-	-	-	-	-	7	819	6657	642	1.21	100
TOTAL MEAN	68	592	3087	2262	1.18		61	529	2186	1677	1.17		141	539	2456	2072	1.16	